UNIVERSITY OF SASKATCHEWAN

Department of Computational Science

CMPT 422.3/835.3

Final Examination

CLOSED BOOK

Time: 2½ Hours April 17, 1993

INSTRUCTIONS:

1. There are five questions on this examination. They may be answered in any order, but all five are to be answered.
2. Read each question carefully and take time to plan your answer. A portion of the marks for each question will be awarded for the organization, clarity, and precision of the answer.
3. Apportion your time according to the indicated mark values.

Marks

10 1. (a) Three ingredients are needed to make a cheeseburger: a meat pattie, a bun, and a cheese slice. Consider a system in which there are three "customer" processes seated at a table; one of them has a supply of meat, one has a supply of buns, and the third has a supply of cheese. A fourth process, the "supplier", has a supply of all three. Assume all supplies are limitless. The supplier places two ingredients (selected arbitrarily) on the table. The customer who has the third ingredient can then make and eat a cheeseburger, signalling the supplier upon completion. The supplier then puts another two of the three ingredients on the table and the cycle repeats.

Present a solution to this problem in which the customer and supplier processes are properly synchronized using semaphores (and P and V operations).

10 (b) There are two basic approaches to interprocess communication in an operating system: the shared memory approach and the message passing approach. Discuss the advantages and disadvantages of each approach.

5 2. (a) Explain what a deadlock is and what problems it might cause in an operating system.

10 (b) There are two basic approaches to dealing with deadlock in an operating system. Explain what these are and give the advantages and disadvantages of each approach.

5 (c) Why might deadlock be more difficult to deal with in a distributed environment?

5 3. (a) Kleinrock's Conservation Law tells us that a particular weighted sum of completion times is invariant to the scheduling discipline used. Explain what this means with respect to the performance of scheduling algorithms.

5 (b) Explain the differences in the degree to which the following scheduling algorithms discriminate in favour of short processes.
(i) FCFS
(ii) RR
(iii) FB

10 (c) Consider the following preemptive priority scheduling algorithm based on dynamically changing priorities. Larger priority numbers imply higher priority.

When a process is waiting for the CPU (i.e., in the ready queue but not running), its priority changes at a rate α; when it is running, its priority changes at a rate β. All processes are given a priority of 0 when they enter the ready queue. The parameters α and β can be set to give many different scheduling algorithms.

Describe the algorithm that results when:

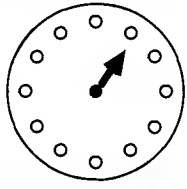
(i) $\beta > \alpha > 0$.

(ii) $\alpha < \beta < 0$.

10 4. (a) Give intuitive definitions of *temporal locality* and *spatial locality*. Explain how we can attempt to capitalize on each of these phenomena in the management of virtual memory.

10 (b) The phase/transition model is a useful model of program behaviour. Describe the model and indicate how it might be useful.

10 5. (a) The *Clock Algorithm* for page replacement decisions considers the pages currently resident in memory to be arranged in a circular queue like the markings on a clock. A pointer travels around this queue, like the hand of the clock. Associated with each page is a reference bit that is turned on each time the page is referenced.



With this simple organization it is possible to implement approximations to some of the more familiar page replacement algorithms. Explain how the following algorithms could be approximated with this scheme:

(i) Least Recently Used (LRU)
(ii) Working Set (WS)

5 (b) It has been said that a computer system is a community of resources, and that a comprehensive approach to resource management is the only reasonable approach. Discuss the role of the SRM component of the MVS operating system in this regard.

THE END

100 marks